

SUPPORTING MATHEMATICS TEACHERS TO INCREASE RETENTION

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National reports have identified the need to increase the pool of highly qualified mathematics teachers as a way to improve mathematics education. However, providing high quality mathematics education for all students goes beyond the recruitment of knowledgeable teachers. This working group is designed to offer an opportunity to examine the role that professional development and support play in the work and retention of mathematics teachers. Retention focuses on new teachers, especially those in urban areas and mathematics teachers in hard-to-hire settings. Discussions concentrate on the study of interventions through Professional Development and Support Models. Efforts to deepen our understanding of the complex and multifaceted picture of why teachers leave and why they stay, and how efforts to retain teachers impact their work in the classroom and their decisions to stay or leave, are developed through the sharing of research designs, data collection, and on-going results. This working group is appropriate for anyone who has work to share or who is thinking about supporting a retention project. Throughout, we address this very complex task in terms of both the opportunities and challenges for mathematics education researchers to provide quantitative and qualitative input on a major political issue. It is hoped that this working group will enrich the dialogue about a national crisis in mathematics education.

Brief Overview of the STIR Working Group

The Supporting Teachers to Increase Retention Working Group was launched in 2009 at PME-NA 31 in Atlanta, GA to investigate the relationship between Professional Development/Support and the retention of mathematics teachers. A second meeting in 2010 at PME-NA 32 in Columbus, OH elaborated on this initial ground work and directions identified for participants to focus on. Over the past two years, a total of 16 participants attended the working group sessions aimed at identifying the gaps in the research on mathematics teacher retention in order to move forward in tackling this complex national issue. The emerging dialogue was based on the results of research studies and ideas of the participants. Participants shared their backgrounds and interests in retention issues, and discussed potential research directions with the ultimate goal of addressing key research issues that would constitute a research agenda for the group. Participants were interested in examining the on-going preparation, support and retention of grade 7-12 mathematics teachers from a variety of angles, including: (1) Impact of Professional Development on Teacher Retention ; (2) Relationship between Content Knowledge and Retention ; (3) Obtaining Research that examines the Dimensions of Professional Development and Support that impact Retention. The overarching question of Mathematics Teacher Retention is often overlooked under the assumption that effective professional development would in essence lead to increased retention. However a closer look at what type of support helps teachers stay in their school, let alone their profession is

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necessary.

At PME-NA 32 in Columbus, OH, the group elaborated on the research agenda that was outlined at PME-NA 31 in Atlanta, GA. To stimulate discussions, members of the group provided summaries of on-going projects to be discussed during the group meeting sessions. These projects fall under the following categories: (1) Role of technology in support/retention; (2) Professional support community that reflect the building of networks and contacts to support work, decisions, challenges, and opportunities that arise in the teaching of mathematics, including lesson study and electronically-based communities of practice; (3) Role of leadership and/or career enhancement in retaining mathematics teachers, including the PD directed towards new teachers entering the field through alternative certifications, those coming from other careers and shifts in PD needed as new teachers move through the challenges of their first 5 years of teaching; (4) Content-based Professional development with emphases on conceptual linking and problem solving; and (5) Research issues that arise in examining teacher retention.

Issues of Psychology of Mathematics Education to be Focused on

The study of the relationship between Professional Development and Support Models on the work and retention of mathematics teachers in grades 7 – 12 merits careful examination. Several national reports have pointed to the need to increase the pool of highly qualified mathematics teachers as a way to improve mathematics education and maintain the United States' economic competitiveness (National Academy of Sciences, 2007; Glenn Commission, 2000). However, providing high quality mathematics education for all students goes beyond the recruitment of mathematically knowledgeable teachers to encompass issues of teacher support, professional development, and retention. Over the past two decades, analyses of teacher employment patterns reveal that many new recruits leave their school and teaching a short time after they enter. Ingersoll, using data from the School and Staffing Survey concluded that in 1999-2000, 27% of first year teachers left their schools. Of those, 11 percent left teaching and 16 percent transferred to new schools (Smith and Ingersoll, 2003). Earlier research revealed that teachers who leave first are likely to be those with the highest qualifications (Murnane and other 1991; Schlechty and Vance 1981). This “revolving door” problem is even worse in large urban districts; for example, 25% of the teachers new to Philadelphia in 1999-2000 left after their first year and more than half left within four years (Neild and other 2003). In Chicago, an analysis of turnover rates in 64 high-poverty, high-minority schools revealed that 23.3 percent of new teachers left in 2001-2002.

Reasons for the lack of retention of new teachers and teachers in high-poverty schools are often related to “working conditions” and lack of support (Ingersoll, 2001; Smith & Ingersoll, 2004; Johnson et al., 2004), though pay also plays a role (Hanushek, Kain, & Rivkin, 2001). This support includes professional and collegial support such as working collaboratively with colleagues, coherent, job-embedded assistance, professional development, having input on key issues and progressively expanding influence and increasing opportunities (Johnson 2006). Preparation, support, and working conditions are important, because they are essential to teachers' effectiveness on the job and their ability to realize the intrinsic rewards that attract many to teaching and keep them in the profession despite the relatively low pay (Johnson & Birkeland, 2003; Liu, Johnson, & Peske, 2004).

A status report on teacher development focusing on professional development and support of teachers (Darling-Hammond et al, 2009) summarized findings and put forth recommendations for effective professional development. The basis for the paper included national surveys with

self reported data, a meta-analysis of 1,300 research studies, and specific studies. The conclusion is that “well designed” professional development can influence teacher practice and student performance. The paper focuses on what is or could be regarded as well designed. One strand of the paper is that of effective support for new teachers. Although half of the states require support for new teachers (Education Week, 2008) it was found that rates of participation in teacher induction programs varied by school types with highest rates in schools with the least poverty and lowest in schools with high levels of poverty. Beyond the rates of participation and availability of support, there is the question of what is effective support. The paper cites an on-going large-scale research project currently underway, which aims to measure the impact in terms of classroom practices, student achievement and teacher mobility. Initial results seem to reflect the difficulty in identifying the impact of support.

Another study presently in its fourth year, Supporting Teachers to Increase Retention (STIR) is studying the relationship between retention and support of mathematics teachers across the state of California. This five-year study is looking through the lens of 10 sites with different support models to relate retention to content knowledge, classroom practices, professional communities of support, leadership and needed support. Initial results are complex but are showing relationships between sustained professional development and support and teacher retention. Data collected to establish a base line for retention across a five-year period 2002-2006 preceding STIR shows that yearly attrition averaged 20% across all 10 sites. For the five-year period the attrition average was 54% with sites reporting an attrition of mathematics teachers as high as 73%. In the first year the attrition dropped from 20% to 14%. Three years of data and results of intervention are now available for sharing. But, what is the relationship between the support and the retention? One of the 10 sites from this study observed that success of a retention initiative takes root in a variety of needs: the need to know your District and its teachers – a need that is often addressed by established, long-term relationships between the university and district leaders; the need to offer sustained support as opposed to punctual interventions in order to break the isolation of beginning teachers and to create a sustainable community; the need to establish relevance of the professional development activities proposed by engaging participants in deep introspection of their own knowledge gaps; the need to involve all players in the community to prevent miscommunication from annihilating attempts made towards change; the need to nurture the community created by moving its members forward into roles and responsibilities they are ready to take on; and last but not least, the need to refine even successful models to keep the momentum (Felter & Faughn, 2009). These findings align with prior research emphasizing that support must be specific in addressing the needs of teachers in their particular context (Fulton et al., 2005).

As indicated in the comments above, support comes from multiple sources. Another recent study from Peabody College, Vanderbilt University, finds that principals play a critical role in the support of new mathematics teachers (McGraner, 2009). This confirms Ingersoll’s recent analysis of Mathematics and Science teacher turnover from the past two decades indicating a steady increase in the phenomena. Since the existing pool of Mathematics and Science teachers is not as well supplied as in other non-STEM disciplines, this increase is not easily absorbed by individual schools, even though enough newly qualified teachers are produced each year to cover increases in students’ enrollment and the effects of retirement. Indeed, upon leaving their teaching position, Mathematics and Science teachers are more likely to opt for non-educational professions than teachers in other fields. According to data gathered by the National Center for Education Statistics with the School and Staffing Survey and the Teacher Follow-up Survey, the

provision of useful Professional Development is one of the organizational factors influencing choices of Mathematics teachers to leave or remain in their positions. Another factor is the degree of individual classroom autonomy (Ingersoll & May, 2010). But how do we successfully involve principals in supporting professional development that increases retention?

Finally, an additional aspect of the issue at stake is the retention of mathematics teachers entering the profession through alternative certification as brought up by one working group participant. In a presentation to the group at PME-NA 2009, Brian Evans emphasized retention issues within the New York City Teaching Fellows program and provided us with the following literature review: “Teachers leave teaching in New York City for three reasons (Stein, 2002): retirement, leaving the profession, and transferring to a school outside New York City. [...] A concern with alternative certification is lack of retention, especially in large urban areas such as New York City (Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005). Sipe and D’Angelo (2006) found when surveying Fellows that about 70% of them intended to stay in education. NYCTF reports that 89 percent of Fellows begin a second year of teaching after the completion of their first year (NYCTF, 2008). Boyd, Grossman, Lankford, Michelli, Loeb, and Wyckoff (2006) reported that about 46% of Teaching Fellows stay in teaching after four years as compared to 55% to 63% of traditionally prepared teachers. Kane, Rockoff, and Staiger (2006) found that Teaching Fellows and traditionally prepared teachers have similar retention rates. Further, Tai, Liu, and Fan (2006) claim that alternative certification teachers, in general, have comparable commitment to the teaching profession as do traditionally trained teachers. In a survey of 31 Teaching Fellows, 90 percent said they were considering leaving their high needs schools for better schools in or outside of New York City, or leaving the teaching profession altogether (Stein, 2002). [...] Similar to results found in other studies (Costigan, 2004; Cruickshank, Jenkins, & Metcalf, 2006; Evans, 2009), teachers were very concerned with student behavioral problems and unsupportive administration.” (Evans, 2009) During the 2010 meeting, Evans elaborated on these findings by incorporating information about the Teach of America Program: “Darling-Hammond, Holtzman, Gatlin, and Heilig (2005) cautioned that, upon becoming certified, many TFA teachers leave teaching. This is in contrast to Teach for America’s own report of retention of TFA teachers on their website. TFA claimed that about two-thirds of TFA teachers stay in the field of education upon completing their time in the program, and half of those remain in teaching. This means about one-third of all TFA alumni stayed in the classroom upon fulfilling their commitment, and another one-third maintained non-teaching roles in education, such as in administration or advocacy (TFA, 2008). As of 2010, there were 17,000 TFA alumni (TFA, 2010). According to TFA, over 5600 TFA members remained teaching in the classroom after their commitment ended (TFA, 2009).” (Evans, 2010)

This working group is designed to offer a comprehensive, multifaceted examination of the ongoing preparation, support and retention of 7-12 grade mathematics teachers based on the results of research studies and ideas of the participants. It is hoped that this working group will enrich the dialogue relating the “support gap” and the work and retention of teachers of mathematics. It is also expected that this working group will propose areas ripe for further research. In light of national efforts to close “poor performing schools” this work to identify ways to improve retention of mathematics teachers becomes especially critical.

Year 1 & 2 of the Working Group: Summary

A Summary Report from the first two years of the working group is included below. This year's proposal builds upon the proposal from last year by integrating participants' research interests and focusing the discussions around four major themes relating to teacher retention. A reference list produced by combining the references from the proposal and work of the first two years is found at the end of this proposal.

Summary Report: Activities of Working Group PME-NA meetings 2009 & 2010

Participants: *Douglas Owens (Ohio State University, OH); Drew Polly (UNC Charlotte, NC); Candice Ridlon (UMES, MD); Brian Evans (Pace University, NYC); Christine D. Thomas (Georgia State University, GA); Ellen Clay (Drexel University, PA); Allyson Hallman (UGA, GA); Michael Meagher (CUNY, NYC); Barbara Pence (SJSU, CA); Axelle Faughn (WCU, NC); Nancy Schoolcraft (IN); Terran Felter (CSUB, CA); Molly Fisher (University of KY); Jacqueline Leonard (UC Denver, CO); Sharilyn Owens (ASU, NC).*

Participants were asked to consider the question "Can support impact teacher retention?", and more specifically "What are the different aspects of support? How is impact measured? What are opportunities and challenges encountered when researching teacher retention?" The major task for our first session consisted of coming up with directions to work and identifying missing foci in literature. Participants organized the questions and interests into four main categories that emerged from the initial brainstorming: Impact of Professional Development on Teacher Retention; Content Knowledge and Retention; Research issues and Retention; Equity and Retention. A detailed list of questions arranged by interests under the four major themes can be found in the 2009 Working Group Summary (Faughn, Pence, Thomas, 2010).

Further discussions underlined that PD must be sustained, long-term, and involve a community of learners: Mentoring necessitates careful pairing, could be done through videotapes and reflections; Decreasing the number of preps for beginning teachers could provide more time for planning and reflecting; We need to connect retention to student learning: Is seeing students succeed part of teacher perceived success that could help with retention? i.e., would evidence of increased students' performance help build confidence & a sense of competence? Finally, advantages of "whole school" reforms and developing leadership skills of individuals to bring PD back to their site were emphasized to increase onsite presence through lesson study, lesson planning, online community, coaching, and/or videotapes.

In addition to identifying interest and gaps from the literature, participants shared the following models of support:

- Σ Brian Evans – NYCTF literature review
- Σ Drew Polly – UNC Charlotte - Researcher-beginning teacher onsite mentorship
- Σ Candice Ridlon – PD through reform curricula in Utah
- Σ Axelle Faughn – Addressing content knowledge through higher education courses
- Σ Barbara Pence – CMP STIR 10 sites, 10 models
- Σ Christine Thomas – Developing an online community of support

The core question of the relationship between Professional Development/Support and retention was significant and central to all discussions but due to lack of directly related research, formed the springboard for lists of questions. The 2010 working group built a more focused and active research based on active engagement of participants in productive reflection on the issues

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across projects. After a review of previous work for new participants, two main breakout groups aimed at lay the foundations of publishable collaborative work. Returning participants were asked to inform the group of any progress they made in their respective projects. Ideas were then shared on further work and dissemination in order to better define the direction of our efforts. In response to the question “Where do we want to go from here?”, several options were put forward, including developing research and papers, participation in future conferences (New Teacher Center; AERA; 2012 Symposium on Mathematics Teacher Retention), establishment of a website/webbase on teacher retention, draft of a monograph on teacher retention, write up of a joint paper for an editorial journal (NCTM/AMTE), and ultimately publication of a book on Professional Development (Math content, Technology, Communities of Practice, Leadership) aimed at teacher educators who focus on bridging research and practice. This brainstorming was followed by a detailed overview of breakout groups by group leaders.

Description and Summary of 2010 Breakout Sessions Listed by Category

(1) Category A: Role of technology in support/retention (Axelle Faughn).

We discussed issues pertaining to the role of technology in empowering teachers both in the classroom and the larger mathematics education community. Questions to address include: (1) What model of PD has been provided that engaged participants in technology use? (2) What trends are you noticing in technology use by teachers? (3) Are you able to relate technology to Retention or Leadership? (4) What constitutes technology in the work of mathematics teachers? (5) What are issues related to equity when working with instructional technologies?

Background: Teachers constantly ask for engagement strategies, including games, technology, etc. Students live in a technology-embedded world; how does this affect their learning schemes? How can teaching take this into consideration? Teachers are often less technology-savvy than their students. How do we support teachers in increasing confidence and competence on learning the instrumentation, shifting from learning to use technology to using it for teaching math, staying up-to-date with new technology (at T³ last year many teachers were looking for TI-84 talks, but most presentations focused on the TI-NSpire)

Questions/Issue:

- How can we best support teachers to acquire TPACK?
- Can technology help with student engagement/collaborative learning, student learning for understanding, teacher leadership, teacher retention, and access to higher cognitive demand tasks?
- What different types of technology are involved in the work of mathematics teachers and how do they support teaching: Technology for presentation purpose and/or planning; Technology for conceptual learning; Technology for Community Building (Teachers, students)
- How do we collect evidence of support through technology? (Use TPACK qualitative framework and TPACK stages of development)
- What type of technology do teachers tend to embrace first?

Work was shared about teachers using the TI-Navigator, looking at discourse through case studies (CCMS).

- Other issues raised in the discussion: How do we bring communities of practice into an online environment? What is the promotion step beyond being a Master Teacher except for leaving the classroom? (Coach, Higher Ed.)

Work in Progress: AERA paper to be presented in April 2011 in New Orleans, LA, on four CMP-STIR sites.

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(2) Category B: Professional support community that reflect the building of networks and contacts to support work, decisions, challenges, and opportunities that arise in the teaching of mathematics, including lesson study and electronically-based communities of practice (Christine D. Thomas).

We share our evaluation and synthesis of the literature on Second Life, professional development within a PLC, and distance learning used in our participatory action research study of this Second Life project. The Second Life project that spans August 2009-May 2011 aims at: (1) sustaining mathematics teachers who are attempting to improve their teaching and students' learning and (2) conducting research for the dissemination of knowledge on retention of secondary mathematics teachers in these schools. We use this as an opportunity to share our understandings, interpretations, and analysis of the literature on the topic as it relates to the goals, and needs of the urban community and the mathematics teachers we serve. In addition, we share our beginning analysis, and initial findings of the study based on the baseline data collected.

Background: Description of work with an Online Professional Community of Teachers in Second Life in Atlanta, GA, allowing for more convenience and flexibility in the offering of PD, and enhancing opportunities for teacher leadership.

Themes: Online learning, social theories of learning (situated learning), Peer leadership, Adult learners.

Questions/Issues:

- Finding a framework for looking at the dimensions of teacher retention through online professional learning communities, especially for teachers in high need schools – Suggestion was made to investigate Collective Efficacy within Communities of Practice
- How do we protect users through modeling and training on the ethical use of technology?
- How do teacher leaders reinforce retention? How can teachers become more integral parts of the school leadership?
- Other issues raised: What type of mathematics is discussed among teachers? Is generating a professional community of mathematics teachers online different from other such communities in other disciplines, in other words, how do you provide math PD online?

Work in Progress: One paper in press and one paper to be presented at AERA 2011.

(3) Category C: Content based Professional development with emphases on conceptual linking and problem solving and establishing collaboration with mathematicians (Imre Tuba)

Background: Professional Development and Mathematical Understandings

- Mathematical Knowledge (Kathy Heid) –Mathematical Thinking – Problem Solving
- Mathematical Knowledge for Teaching – D. Ball
- Integrated Pedagogy and Math Content

Questions:

- Does content *driven* PD result in improved mathematical understanding?
- Can the PD content be linked to classroom practices?
- How does this effect retention?

Data:

- Pretest/Posttest on Content
- Beliefs about content understanding relative to content to be taught (Confidence, Competence)
- Classroom practice (Self reports, Classroom Observations)

Work in Progress: Specific to Imperial Valley site

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- Content tests linked with self reported changes in classroom practices
 - Overview of PD
 - Pre/Post results (Full test, Scales)
- Classroom observations and self reported reflections relative to the PD
 - Confidence and Competence

Plans for the Third Year of the Working Group

In advance of the conference, last year's participants will be surveyed to identify any questions or shifts in foci that occurred this year. Additional people will also be contacted. The Supporting Teachers to Increase Retention 2011 working group comes in conjunction with the working group organizers' endeavors to promote discussion and raise national awareness of the issue of Mathematics Teacher Retention through a Mathematics Teacher Retention Symposium to be held March 22-24, 2012 in Los Angeles. In preparation for this symposium, several documents have been drafted that will support the work of this working group, namely a clear statement of the current problem in Mathematics Teacher Retention, a list of guiding principles in attempting to address this national issue, and a list of guiding questions aimed at advancing research-based knowledge. All these will be shared with working group participants ahead of time, and will inform the directions and foci for the 2011 meeting.

Additionally, recent work by Ingersoll and May (2010) on the current national trends in mathematics teacher retention will guide some of the discussions and questions for the group to ponder in light of their own on-going projects. In particular Ingersoll and May investigated mathematics and science teachers' turnover using data from the Teacher Follow Up Survey through the lenses of **Magnitude**, **Destinations**, and **Determinants**. In preparation for this Working group, participants will be asked to read and report on these findings.

Regarding Professional Development and Support, we will continue to explore the themes of Technology, Online Professional Communities, and Content Knowledge. Additionally, models of Communities of Practice through Lesson Study, and establishment of leadership roles for teachers to support retention will specifically be addressed. Participants interested in examining the Lesson Study theme will address implementation strategies and techniques for implementing lesson study. Questions to be discussed include: (1) What is the timeline for planning, teaching and re-teaching? (2) How do teachers define/identify misconceptions by students? (3) How and what do teachers decide in changing their lesson? (4) Who is involved in the Lesson Study planning and implementation? We also plan on exploring the role of early-career leadership and/or career enhancement in retaining mathematics teachers, including the shifts in PD needed as new teachers move through the challenges of their first five years of teaching.

The general outline of the three days of the working group will include:

- Day 1**
 - Introductions and Review of past years' work and update on work by those who are attending, including review of new literature
 - Overview of MTRS and reflection/focus on work by Ingersoll and May in small groups
- Day 2**
 - Introductions of new attendees
 - Breakout groups around new and old themes chosen by participants
 - Brief discussion of issues addressed in each group
 - Small group work focused on challenges and knowledge base
- Day 3**
 - Breakout group reports and future directions

The productivity of the working group will be a function of the advanced organization. But at this point, we anticipate that the breakout groups will either continue to address the questions

generated from the previous years' discussions, or attempt to tackle new directions in light of recent research findings.

Anticipated Results of the Working Group

To continue addressing the particular issues of retention and technology, retention and community, retention and leadership, and/or retention and content-based professional development, each participant will share a description of the work to date in their project, the stage of development the project is in, research design and instrumentation, and a summary of current findings. Joint collaboration was already successful through the efforts of this Working Group to disseminate findings at the 2011 meeting of AERA. As noted earlier, the organizers of the working group plan to solicit more papers emerging from this collaborative work, and possibly the development of a monograph synthesizing our work on mathematics teacher retention and support.

The network will also be included in the development of a Mathematics Teacher Retention Symposium (MTRS), sponsored by the CMP-STIR group, to take place in spring 2012.

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